

NEUROLOGIC HEALTH

Acrolein and Neuro Disorders

Neurologic disorders are among the leading causes of death and illness in the United States. Their causes are poorly understood, but one of the emerging suspected culprits is the substance acrolein, which tends to be significantly elevated in the brains or spinal cords of people who have Alzheimer disease, Parkinson disease, amyotrophic lateral sclerosis (ALS), and other neurologic disorders.¹⁻⁴ A new study adds multiple sclerosis (MS) to the list of disorders potentially affected by this substance.⁵

Acrolein is produced naturally in the body as a by-product of membrane lipid peroxidation. It also occurs in combustion by-products such as vehicle exhaust, industrial emissions, oil- and coal-fired power plant emissions, cooking fumes, and the smoke from burning cigarettes, wood, and plastics. It's used as a biocide and to manufacture other chemicals and products such as chemical weapons. The U.S. Environmental Protection Agency (EPA) has determined the ubiquitous pollutant is a major source of respiratory damage.⁶ But information on the neurologic effects of environmental acrolein is scant.

In the new study, Riyi Shi of Purdue University and colleagues injected mice with substances known to induce experimental autoimmune encephalomyelitis, an animal model for MS.⁵ Within 2 weeks acrolein-lysine adduct levels in the spinal cord began to rise, peaking at 65% higher than in controls at about day 20. At the same time, the mice began to display significant muscle control problems. Treatment with the acrolein-scavenging substance hydralazine reduced those effects to a great although not significant degree. The researchers also detected significant mitigation of damage to the myelin sheath by hydralazine.

Shi and colleagues say their study provides the first evidence that endogenous acrolein plays a key role in MS. Shi says it's plausible that environmental acrolein can act in the same general way: "There's no reason not to believe that the same type of damage could occur."

Richard LoPachin, a neurochemist and director of research at

Montefiore Medical Center in New York, partially agrees. "Because acrolein is highly reactive with proteins at the site of exposure, it has limited distribution in the body and, therefore, limited access to the brain," he says. But acrolein is just one of many type-2 alkenes, a large family of environmental and food contaminants that includes acrylamide, methyl vinyl ketone, methyl acrylate, and 4-hydroxynonenal. LoPachin says type-2 alkenes share a common mechanism of action at nerve terminals in the brain, and he thinks the combined effects of these substances could contribute to some neurologic disorders.

Robert Kavlock, director of the EPA National Center for Computational Toxicology, says acrolein's physical properties make it difficult to assess the compound using the agency's ToxCast™ high-throughput chemical screening program using currently available technology.⁷ But pinning down the causes of these neurologic disorders could help millions of people. In the United States alone, about 5.3 million people have Alzheimer disease,⁸ about 1.5 million have Parkinson disease,⁹ about 400,000 have MS,¹⁰ and about 30,000 have ALS.¹¹

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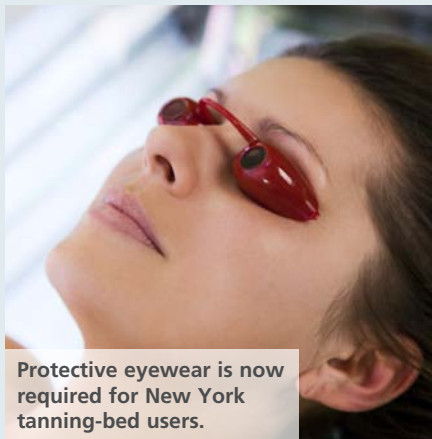
The Beat

by Erin E. Dooley

NY State Tanning Bed Regs

Newly implemented regulations on indoor tanning salons put New York State in the company of almost a dozen states by restricting indoor tanning for children.¹ New York children under age 14 may no longer use such facilities, and older teenagers must have signed parental consent. Adults must

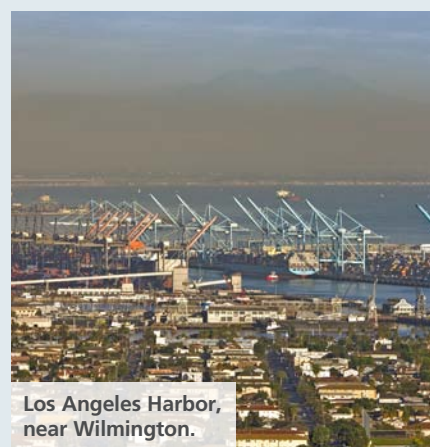
acknowledge they are aware of the hazards of indoor tanning and receive instruction in the use of tanning devices. Among other requirements, tanning facility operators in New York State must provide free protective eyewear to customers and ensure customers use it.



Protective eyewear is now required for New York tanning-bed users.

Air Filtration Devices for Port Community Schools

California's South Coast Air Quality Management District has approved the installation of high-performance air filtration devices at 47 schools in Wilmington, a community heavily polluted by shipping and transport activity at the Port of Los Angeles.² The decision follows a demonstration project showing the devices removed up to 90% of diesel and ultrafine particles from air inside the classrooms. Funding for the project comes from a settlement with the City of Los Angeles and community groups to mitigate environmental impacts of the TraPac Container Terminal Expansion Project



Los Angeles Harbor, near Wilmington.

at the Port of Los Angeles. The devices will be installed this spring.

Tap Water and Hypospadias

Inconclusive evidence to date has suggested a potential link between exposure to trihalomethanes (THMs), a tap water disinfection by-product, and hypospadias, a

AQUACULTURE

A Second Look at Sea Lice

A new study has reopened an old debate over the potential health risks that fish farms pose to wild fish populations, concluding that “productivity of wild salmon is not negatively associated with either farm lice numbers or farm fish production.”¹ The paper by Gary Marty, a research associate at the University of California, Davis, and fish pathologist with the British Columbia Ministry of Agriculture, and two colleagues pooled data from fish farms in western Canada with data first presented in 2007 by Krkošek et al.² The earlier paper concluded that infestations of ectoparasitic sea lice from salmon farms were driving a decline in wild pink salmon (*Oncorhynchus gorbuscha*) populations in British Columbia’s Broughton Archipelago and that extinction would occur if the infestations continued.

Sea lice pose no direct threat to humans who consume the fish; furthermore they’re removed during the harvesting process. But the new study¹ contributes to the larger ongoing discussion of whether a large-scale aquaculture industry can be sustainable in terms of human and ecosystem health.

Marty says earlier analyses omitted relevant factors from a medical perspective—that is, a diagnostic approach to fish health and epidemiologic factors, rather than a model-driven analysis. For the new study, he and his colleagues obtained proprietary monthly sea lice data from fish farms in the region, giving what they call a fuller picture of the salmon decline in 2001–2002 than the previous analyses, which relied on sea lice counts from wild fish only.

According to Marty, the new analysis suggests pink salmon populations are within a natural pattern of fluctuation. “Our paper estimates that sea lice numbers on farmed fish were greater in 2000 than in 2001, and the wild pink salmon exposed to those sea lice in 2000 came back in record high numbers in 2001,” he says.

Martin Krkošek, lead author of the 2007 paper² and a lecturer in zoology at the University of Otago in Dunedin, New Zealand, says

the new analysis was limited by the omission of data from the affected region prior to infestations as well as nearby regions where there are no salmon farms. Analyses that used the spatial and temporal controls from a larger picture of salmon abundance in the Broughton Archipelago, Krkošek says, “have found effects of sea lice.”^{3,4}

Jeff Silverstein, national aquaculture program leader for the U.S. Department of Agriculture, notes that although the earlier paper² suggested sea lice from salmon farms caused wild salmon declines, “The recent study¹ has managed to show that the correlations don’t appear to be causative.” Ian Bricknell, director of the Aquaculture Research Institute at the University of Maine in Orono, adds, “The epidemiological approach . . . is a much more effective way of analyzing this data.” Bricknell says Marty et al. “looked at many more variables than just lice and salmon (as was done earlier) and have backed it up by testing their model with biological data.”

Krkošek agrees other factors may have contributed to the 2002 decline but strongly disagrees with the conclusion that sea lice do not negatively affect wild salmon productivity.⁴ “While one may speculate about the possibility of other factors that could have contributed, it is known—not speculated—that lice numbers were very high on those fish,” he says.

Marty insists the study’s most important impact lies in showing how medical analysis brings a broader perspective to fish population studies. “I want people to focus on what is actually causing salmon populations to go up and down,” he says. “We should still look at sea lice but include other factors as well.”

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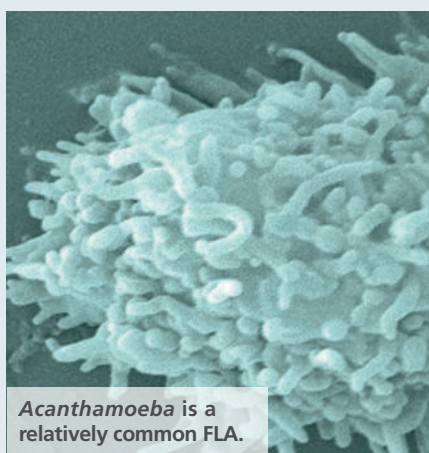
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genital birth defect that affects 70 in 10,000 male births. A study of 471 mother–son pairs showed maternal exposure to THMs did not explain the risk of hypospadias but that women who drank more than a liter of cold tap water per day had a 70% higher chance of having a baby with the birth defect, a finding the authors say needs further exploration.³ They also stress the importance of adequate fluid intake for pregnant women.

Funds to Study Combined Effects of Social Stressors, Pollutants

In January 2011 the EPA announced new grants in support of a nationwide interdisciplinary effort to study poor and underserved communities that have extensive pollution problems.⁴ Funded projects will examine social and societal factors that may modify how pollutants affect human health. The program will focus on multiple pollutants, where programs in the past have generally focused on single chemicals.



Acanthamoeba is a relatively common FLA.

Free-Living Amoebas Common in Water Systems

A growing body of research has shown so-called free-living amoebas (FLAs) increase the quantity and virulence of water-based pathogens such as *Legionella* and *Mycobacterium* spp. A recently published

review shows FLAs can break through water treatment barriers and enter drinking water distribution systems, where they can colonize and grow, especially in reservoirs and home plumbing.⁵ FLAs were found in 45% of the water samples in the studies reviewed, reflecting treated drinking water systems from around the world. The health impact of these prevalent FLAs has yet to be determined.

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